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DRAWINGS ATTACHED

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(54) SHEARS FOR CUTTING PLATE

(71) We, SIEMAG SIEGENER MASCHINENBAU GESELLSCHAFT MIT BESCHRANKTER HAFTUNG, a German Company, of 5912 Hilchenbach-Dahlbruch, Germany, do hereby declare the invention,

for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

In the production of sheet material, more particularly in the rolling-out of metal plate in heavy plate mills, it is necessary to crop the end product, and the cropping is done by cropping shears.

The older kinds of cropping shears such as are used e.g. in heavy plate mills have a stationary horizontal bottom blade and a vertically movable top blade whose cutting edge extends at a cutting angle of from 1°30' to 4° to the horizontal. The reason for using this cutting angle for the movable top blade is to ensure that the shear pressure produced at each cutting stroke remains within limits so that the shears and drive can be of economical construction. The greater the top blade cutting angle and the blade length are in these known shears, the greater must be the overlap of the top-blade cutting edge over the bottom-blade cutting edge at one end of the blades if there is to be reliable severance of the plates at the other end of the blades.

One undesirable result of this top-blade overlap is that the plate rear end, which is beyond the bottom-blade block, is pressed and therefore warped or bent by the overlapping part of the top blade. Every cropped plate therefore has one cropped edge bent and the other cropped edge — the one which was on the bottom-blade block — straight. The warped cropped edge or "shear bow" of the plate is greater in proportion as the top-blade cutting angle and plate thickness are greater.

Shear bow at one end of each cropped plate is a particular nuisance since it cannot be completely removed by subsequent straightening; the straightening treatment experienced by the beginning and end of a plate is less intense than the straightening treatment experienced by the remainder. For many purposes, therefore, the end deformed by shear bow must be removed by a further separating operation, such as flame cutting.

Various endeavours have recently been made to reduce shear bow. For instance, so-called rocking shears — i.e., shears having a stationary bottom blade and a top blade which mades a rocking cutting movement — have been devised wherein the overlap for a given cutting angle is about 50% of the overlap in earlier shears with a rectilinearly moving top blade. These rocking shears therefore crop with a correspondingly reduced amount of shear bow but still do not completely eliminate the same. A considerable improvement in this connection, however, has been provided by rolling cut shears wherein the top blade has a rolling movement which completely obviates the need for overlap between the top blade and the bottom blade. Shear bow can either be completely obviated or kept within tolerable limits on plate material of thicknesses of up to 15 mm and, depending upon the quality of the material, of up to as much as 20 mm with rolling cut shears. At thicknesses greater than 20 mm, however, the known rolling cut shears still cause shear bow in cropping, not because of top-blade overlap but because of the cutting angle which is necessary to limit shear pressure and which is therefore unavoidable.

It is an object of the invention to provide improved shears for cutting plate of various thicknesses.

According to the invention there is provided shears for cutting plate, comprising a top blade movable in a stationary support and having two congruent cutting edges lying in respective spaced apart parallel planes between which the top blade lies, two bottom blades each having a straight cutting edge, one of the bottom plates lying on one side of the space between said parallel planes, the other of the

bottom blades being disposed on a blade block mounted for pivoting in said stationary support, about an axis parallel with its cutting edge, between an operative position in which it lies on the opposite side of said space from said one bottom blade, with its cutting edge parallel with that of said one bottom blade, and an inoperative position, means being provided for moving said top blade parallel with said planes towards and away from the positions occupied by said bottom blades when said pivoted bottom blade block is in its operative position, so that, when said pivoted bottom blade block is in its operative position each said cutting edge of the top blade performs a cutting movement with respect to the cutting edge of the respective bottom blade, and whereby when said pivoted bottom blade block is in its inoperative position only the cutting edge of the top blade associated with said one bottom blade makes a cutting movement with respect to the respective bottom blade, whereby when a plate to be cut is placed between said top blade and said bottom blades, when said pivoted bottom blade block is in its operative position, and the top blade brought towards the bottom blades, the portion of the plate between said planes is severed from the remainder of the plate, so that said remainder is divided, and whereby when a plate to be cut is placed between said top blade and said one bottom blade, when said pivoted blade block is in its inoperative position, and the top blade brought towards said one bottom blade, the plate is divided by a single cut between the cutting edge of said one bottom blade and the associated cutting edge of the top blade.

When the pivoted bottom blade block is in its operative position shears of this kind therefore cut from the plate to be cropped a strip of width corresponding substantially to top blade thickness; the cut edges of the plates on both sides of the removed strip are supported by the bottom blades and therefore protected from shear bow. A narrow strip of scrap is produced at each crop, but the scrap yielded in this way is much less than when cropped plate having shear bow requires further treatment such as flame cutting to remove the end deformed by shear bow. Consequently, the use of shears according to the invention with the pivoted blade block in its operative position not only decreases the production of scrap but also saves one working step compared with shears having only one top blade and only one bottom blade. Since, when used in this way, shears according to the invention make two cuts simultaneously, the shear force required to divide a given plate is twice as great as would be the case if only one bottom blade were used as is the case in shears making only a single cut. However, since the extent to which the scrap strip is deformed is unimportant a larger cutting angle can be employed in the shears according to the invention than can be employed for shears having only one top and one bottom blade and which are required to crop thick plate with an acceptable shear bow, so that the shear force required in the shears according to the invention, when operated with the pivoted bottom blade block in its operative position, can be correspondingly reduced.

For many of the purposes for which cropped plates, even very thick cropped plates, are required, shear bow at one end is of little, if any, importance, and in this case the shears according to the invention can be used with the pivoted bottom blade block in its inoperative position thus effecting a saving in scrap production and operating power required. Furthermore, plates up to 20 mm thick can be cropped by rolling cut shears substantially without shear bow.

In a preferred embodiment of the invention the shears are rolling cut shears and can thus be used, with the pivoted bottom blade block in its inoperative position, to crop plates up to 20 mm thick without substantial shear bow.

One way of adapting the cutting clearance between the cooperating cutting edges of the blades to plates of different thicknesses is for the top blade slide to be movable transversely of its length in some conventional manner, for instance, by an appropriate movement of sliding wedges, so that the top blade can be correspondingly moved transversely in relation to the bottom blade in its stationary block and for the bottom blade mounted on the pivoted bottom blade block to be adjustable transversely, of its length with respect to the other bottom blade. To adjust the cutting clearance between the top blade and the bottom blade in its pivoted block, in the preferred embodiment wedge rods are disposed on the pivoted bottom blade block parallel to the cutting edge, and bear by way of inclined surfaces on complementarily inclined surfaces on elements rigidly secured to the stationary support and can be moved to adjust the cutting clearance between the top blade and the pivoted bottom blade. The pivoted bottom blade block can be held in its required position by means of movable locking pins supported for reciprocation in said stationary support and having inclined surfaces cooperating with complementarily inclined surfaces on the pivoted bottom blade block, the locking pins acting on the pivoted bottom blade block to urge the inclined surfaces on the wedge rods against the complementarily inclined surfaces on said elements.

An embodiment of the invention will be described in greater detail with reference to the accompanying drawings wherein:—

Figure 1 is a view partly in side elevation and partly in vertical section of rolling cut shears according to the invention;

Figures 2 and 3 are sectional views corresponding to Figure 1, with the pivoted blade block in different positions, and

Figure 4 is a view in horizontal section through the cutting clearance adjusting device associated with the pivoted bottom blade.

Referring to the drawings, a stationary support in the form of a column 1 of rolling cut shears has in known manner a stationary bottom-blade block 2 in which a bottom blade 3 is disposed. A top-blade slide 4 is vertically movable in column 1 and comprises a known arcuate top blade 5.

The drive for producing the rolling motion of the arcuate top blade 5 along the straight cutting edge of the stationary bottom blade 3 is of known kind and is therefore not shown in any greater detail in the drawings.

The top blade 5 has two congruent arcuate cutting edges 6, 7, lying in respective parallel vertical planes corresponding to the side faces of the blade 5, edge 6 co-operating with cutting edge 8 of bottom blade 3 while edge 7 of top blade 5 co-operates with a straight cutting edge 9 of a second bottom blade 10 mounted in a second bottom-blade block 11. The blades 3 and 10 lie on opposite sides of the space between the vertical planes of the side faces of the blade 5. The bottom-blade block 11 is secured to a shaft 12 extending parallel to edge 9, and rotatable in the column 1, so that the bottom blade 10 can be pivoted, for instance, through the agency of a rotary drive (not shown) acting on the shaft 12, selectively either into the cutting position shown in Figure 1 or into an inoperative position shown in Figure 3. The position of shaft 12 in block 11 is such that the moments arising in cutting from the shear pressure and from the deflection pressure cancel one another out. The block 11 is on the delivery side of the shears, and a movable roll table 13 is disposed on the delivery side of the block 11 to receive pieces cropped from plate passed through the shears from right to left in Figure 1.

When block 11 is in the cutting position shown in Figure 1, the cutting edges 8 and 9 of the two bottom blades 3, 10 are separated from one another by a distance corresponding to the distance between the cutting edges 6 and 7 of the top blade 5. When the same then makes a cut, a strip of scrap is cut from a plate 14 which it is required to crop and which is supported by the two blade blocks 2, 11; the width of such strip corresponds to the gap between the cutting edges 8 and 9 of the two bottom blades 3 and 10. Since the plate 14 rests flat on the two bottom blade blocks 2, 11 during cropping, the formation of shear bow on the two resulting cut edges is inhibited.

To cut relativ ly thin plates and to crop thick plates where shear bow is unimportant, the roll table 13 can be moved back, to the position shown in Figure 2, whereafter the bottom blade block 11 can be pivoted through the position shown in Figure 2 into the inoperative position shown in Figure 3. Cropping is then performed only by cutting edge 6 of top blade 5 cooperating with cutting edge 8 of bottom blade 3, and so no strip of scrap is produced.

The top blade slide 4 is movable transversely of its length by appropriate movement of sliding wedges (two of which are indicated at 15 in Figure 1), whereby the cutting clearance between the cutting edge 6 of top blade 5 and the cutting edge 8 of bottom blade 3 can be adjusted.

The clearance between the cutting edge 7 of the top blade 5 and the cutting edge 9 of bottom blade 10 can be adjusted by the bottom blade block 11 being moved. The same is held down in its operative position shown in Figure 1 by two wedge rods 16, 17 and by two locking pins 18, 19, all visible in Figure 4. The rods 16, 17 are disposed in the bottom blade block 11 and extend parallel with the cutting edge 9, in opposite directions from a pinion 22, driven by a worm 21, driven by an electric motor 20 secured by flanges to the block 11. The pinion 22 is integral with an axially extending sleeve which has on opposite sides of the pinion, right and left handed screw threads respectively which engage corresponding threads 23 and 24 on the inner ends of the rods 16 and 17 which are received in said sleeve.

The outer ends 25 and 26 respectively of the rods 16 and 17 are provided with inclined surfaces which bear on complementarily inclined surfaces of elements 27 and 28 respectively, rigidly secured to column 1. The pins 18, 19 are mounted on column 1 parallel with the rods 16 and 17 and are reciprocable along their lengths by means of hydraulic piston and cylinder assemblies 29 and 30 respectively. The pins 18, 19 engage in apertures 31, 32 in block 11 and are provided with inclined surfaces which cooperate with complementarily inclined surfaces 33 and 34 respectively on the block.

The dispositions of the inclined surfaces on pins 18 and 19 and the complementarily inclined surfaces 33 and 34 are such that the force acting on block 11 as a result of engagement of pins 18 and 19 with surfaces 33 and 34 tends to pivot block 11 in the

opposit sense from the force acting on the block as a result of engagement of rod ends 25 and 26 with elem nts 27 and 28.

To adjust the cutting clearance between the cutting edges 7 and 9, the rotary drive to the shaft 12 is disengaged, whereafter th pins 18, 19 are withdrawn from the apertures 31, 32. The cutting clearance can now be adjusted to the correct value by the rods 16, 17 being moved outwards or inwards by rotating the pinion 22 in the correct direction. The weight of the block 11 applies to the shaft 12 a moment ensuring firm engagement of the rod ends 25, 26 with the inclined surfaces of the elements 27, 28. After adjustment of the cutting clearance the pins 18, 19 are re-introduced into the apertures 31, 32. If the pins 18, 19 are of the self-locking kind, the hydraulic drives 29, 30 can be so devised that a spring maintains the pins 18, 19 in the locking position, the pistons of the drives 29, 30 being actuated only for the brief unlocking operation.

The invention is not limited to use just in rolling cut shears. Even if there is considerable blade overlap during shearing only the strip of scrap is warped and there is no deformation of the material being cropped, and so the invention may be embodied in rocking shears and in shears having a constant cutting angle.

WHAT WE CLAIM IS:—

1. Shears for cutting plate, comprising a top blade movable in a stationary support and having two congruent cutting edges lying in respective spaced apart parallel planes between which the top blade lies, two bottom blades each having a straight cutting edge, one of the bottom blades lying on one side of the space between said parallel planes, the other of the bottom blades being disposed on a blade block mounted for pivoting in said stationary support, about an axis parallel with its cutting edge, between an operative position in which it lies on the opposite side of said space from said one bottom blade, with its cutting edge parallel with that of said one bottom blade, and an inoperative position, means being provided for moving said top blade parallel with said planes towards and away from the positions occupied by said bottom blades when said pivoted bottom blade block is in its operative position, so that, when said pivoted bottom blade block is in its operative position, each said cutting edge of the top blade performs a cutting movement with respect to the cutting edge of the respective bottom blade, and whereby when said pivoted bottom blade block is in its inoperative position, only the cutting edge of the top blade associated with said one bottom blade makes a cutting movement with respect to the respective bottom blade, whereby when a plate to be cut is placed between said top blade and said bottom blades, when said pivoted bottom blade block is in its operative position, and the top blade brought towards the bottom blades, the portion of the plate between said planes is severed from the remainder of the plat , so that said remainder is divided, and whereby when a plate to be cut is placed between said top blade and said one bottom blade, when said pivoted blade block is in its inoperative position, and the top blade brought towards said one bottom blade, the plate is divided by a single cut between the cutting edge of said one bottom blade and the associated cutting edge of the top blade.

2. Shears according to claim 1 in which the pivoted blade block is disposed on the delivery side in said stationary support.

3. Shears according to claim 1 or claim 2, in which the pivoted bottom blade block is fixed on a shaft pivotally mounted in said support and can be moved by a rotary drive acting on said pivot shaft.

4. Shears according to claim 3, in which the pivot shaft of the pivoted bottom blade block is so disposed that the moments arising in cutting from the shear pressure and from the deflection pressure cancel one another out.

5. Shears according to any of claims 1 to 4, in which rods are disposed on the pivoted bottom blade block parallel to the cutting edge of the respective bottom blade and extend in opposite directions outwardly from a central region, said rods having at their outer ends inclined surfaces which bear on complementarily inclined surfaces of elements rigidly secured to said stationary support and can be moved in opposite directions synchronously to adjust the cutting clearance between the top blade and the pivoted bottom blade.

6. Shears according to claim 5 in which movable locking pins supported for reciprocation in said stationary support hold the pivoted bottom blade block in its required position, the movable locking pins having inclined surfaces which cooperate with complementarily inclined surfaces on the pivoted bottom blade block, the dispositions of said inclined surfaces on the locking pins and their associated inclined surfaces on the pivoted bottom block being such that the force acting on the latter as a result of engagement of the inclined surfaces on said locking pins with the complementarily inclined surfaces on the pivoted bottom blade block tends to move the latter in the opposite sense from the force acting on the pivoted bottom blade block as a result of engagement of said inclined surfaces on said rods with the complementarily inclined surfaces of said elements secured to said stationary support.

7. Shears according to any preceding

claim, constructed as rolling cut shears in which the cutting edges of the top blade are arcuate and arranged to roll along the straight cutting edges of the bottom blades.

8. Shears for cutting plate, substantially as hereinbefore described with reference to the accompanying drawings.

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1322515 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

Fig. 1

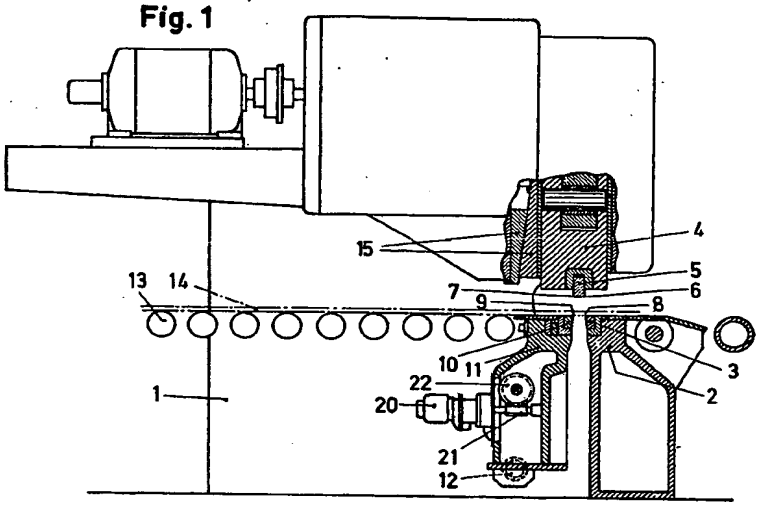


Fig. 2

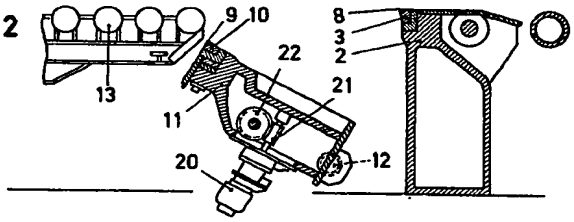
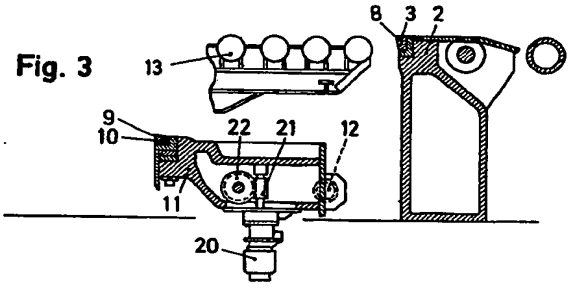


Fig. 3



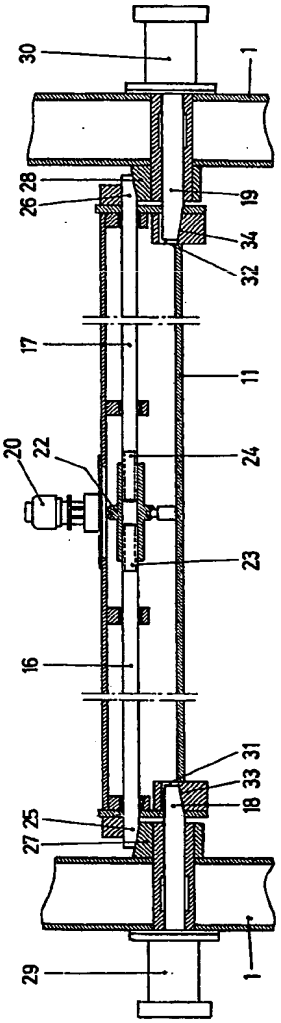


Fig. 4